PESTS NOT KNOWN TO OCCUR IN THE UNITED STATES OR OF LIMITED DISTRIBUTION, NO. 59: RICE STEM NEMATODE

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Pest

RICE STEM NEMATODE
Ditylenchus angustus (Butler) Filipjev

Selected Synonyms

Anguillulina angustus (Butler) Goodey
Tylenchus angustus Butler
Ufra disease, dak pora, akhet-pet

Class: Order: Family

Secernentea: Tylenchida: Anguinidae

Economic Importance

Ditylenchus angustus is a destructive pest of rice causing significant yield losses. In Thailand, rice yields were reduced 20-90 percent in infected fields. In Bangladesh, crop losses of 40-60 percent were reported in certain deep-water rice fields (Miah and Bakr 1977). Cox and Rahman (1980) estimate the average total yield losses in Bangladesh to be 4 percent, with higher losses in wet years.

Hosts

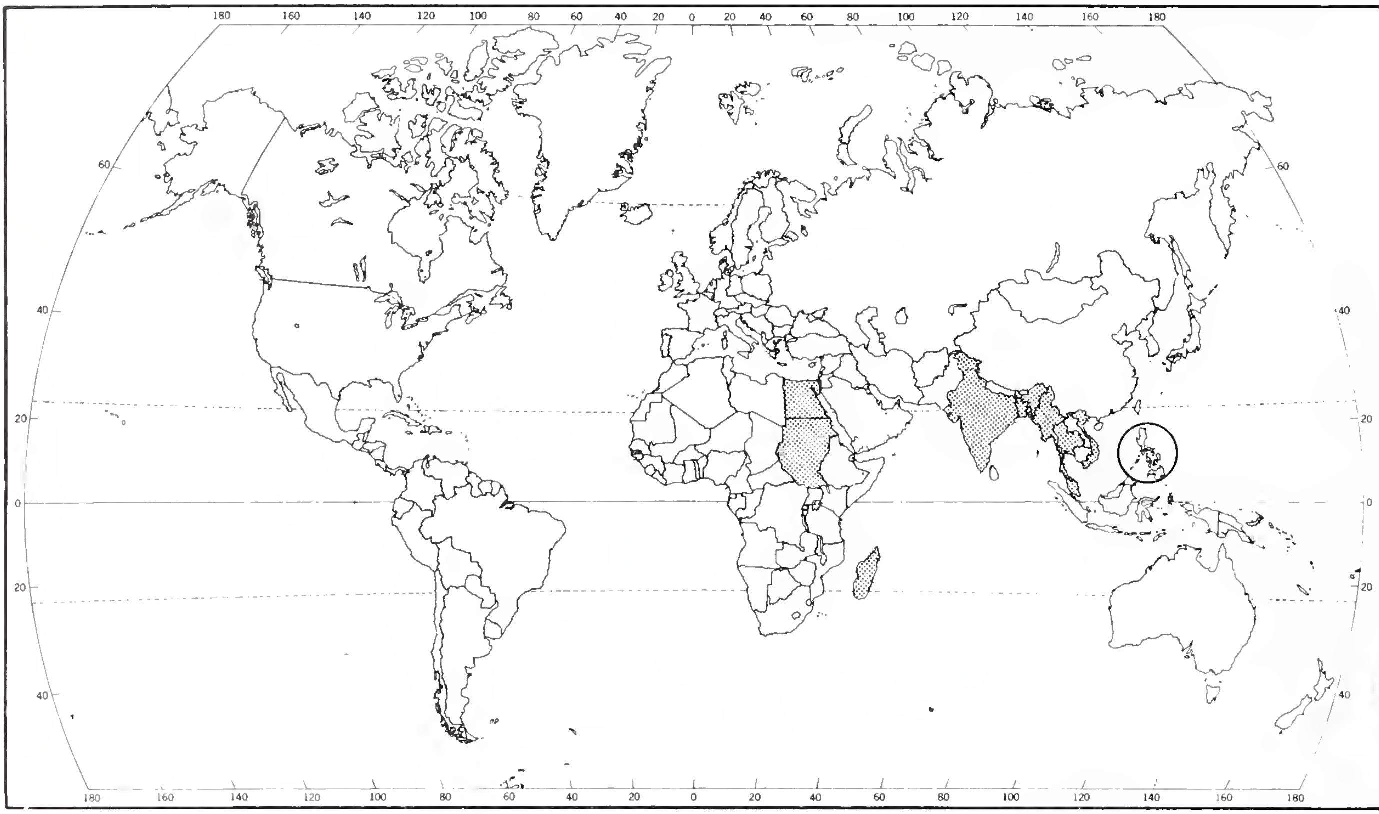
The only known crop hosts of D. angustus are Oryza spp., O. sativa (rice), O. alta, O. eichingeri, O. glaberrima (African rice), O. latifolia, O. meyeriana, O. minuta, O. nivara, O. officinalis, and O. rufipogon (McGeachie and Rahman 1983). The nematode infects the weed hosts Echinochloa colonum (junglerice), Leersia hexandra (southern cutgrass), and Sacciolepis interrupta (Cuc 1982).

General Distribution

D. angustus is known from Bangladesh, Burma, Egypt, India, Madagascar, Malaysia (Malay Peninsula), Philippines, Sudan, Thailand, and Vietnam (McGeachie and Rahman 1983).

Characters

ADULT FEMALE (Fig. 1A) - Body slender, 0.77-1.23 mm long X 0.015-0.022 mm wide, almost straight or slightly curved ventrally when relaxed. Cuticle with fine transverse striations, annules about 1 µm wide at midbody. Lip region unstriated, not distinct from body. Spear (stylet) moderately developed, 10 µm long, conus attenuated, about 45 percent of total spear length, knobs small but distinct (Fig. 1B). Procorpus cylindrical, narrows at esophageal bulb, as long as 3-3.6 times body width in that region. Median esophageal bulb oval with distinct valve anterior to center. Isthmus narrow, cylindrical, 1.5-1.9 times longer than procorpus. Posterior esophageal bulb 27-34 µm long, slightly overlaps intestine. Cardia absent.



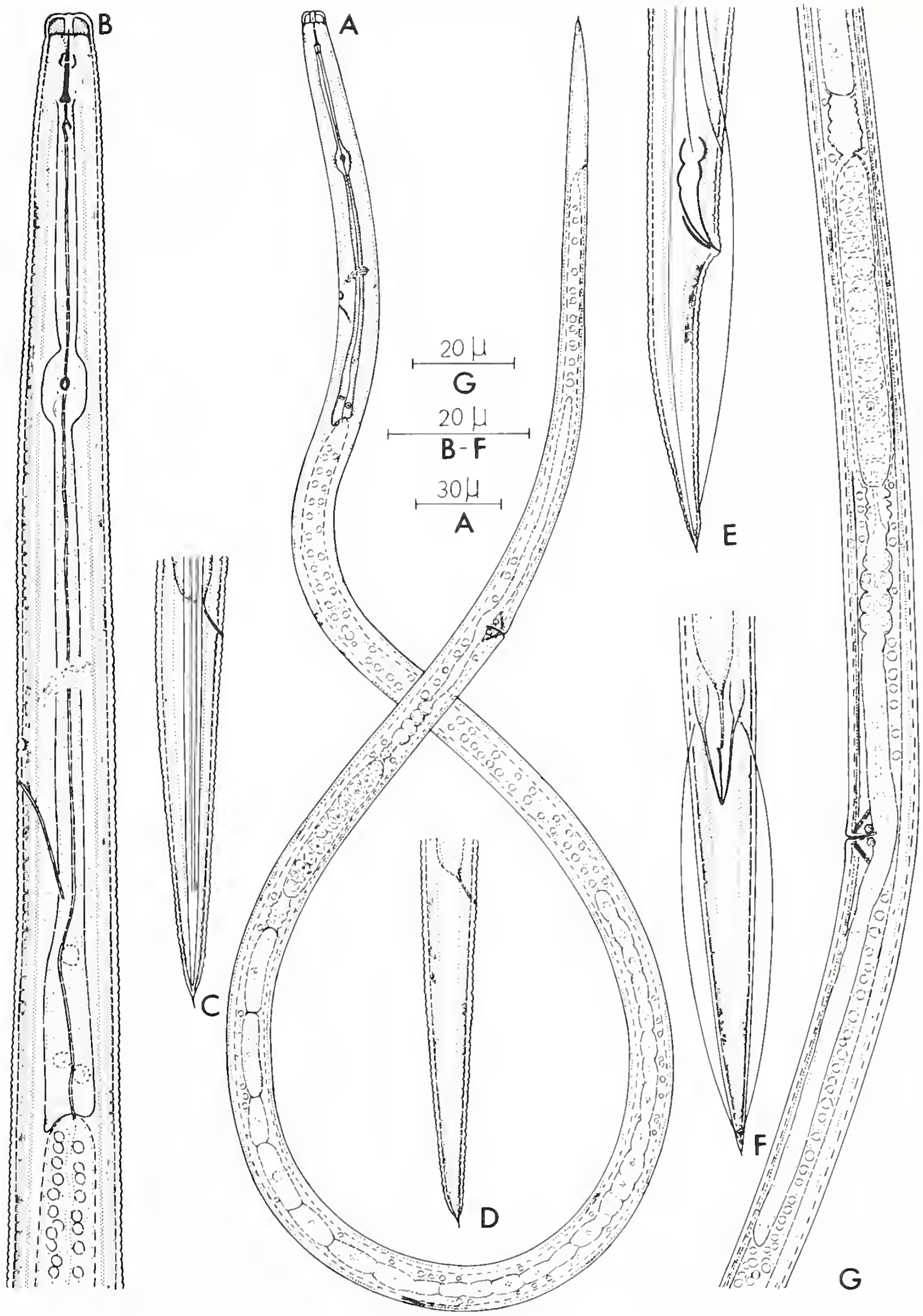
Ditylenchus angustus distribution map prepared by Non-Regional Administrative Operations Office and Biological Assessment Support Staff, PPQ, APHIS, USDA

Nerve ring conspicuous, 21-35 µm behind median esophageal bulb. Excretory pore 90-110 µm from anterior end, slightly anterior to beginning of posterior esophageal bulb. Vulva slit transverse, located 75-80 percent of the way down the body from the anterior end (Fig. 1G). Spermatheca very elongated. Anterior ovary outstretched almost to base of esophagus, oocytes in single row. Posterior uterine branch extends two-thirds distance to anus. Tail conoid (Fig. 1C), tapered sharply to pointed terminus (Seshadri and Dasgupta 1975, Kothekar 1978, Thorne 1961).

ADULT MALE - Morphology similar to female. Body 0.6-1.1 mm long X 0.014-0.019 mm wide. Testis single, outstretched, extending to near base of esophagus. Paired spicules curved ventrally. Bursa extending from opposite the proximal end of the spicules, almost to tip of tail (Fig. 1E, F).

LARVA - Similar in gross morphology to adult. Tail (Fig. 1D) (Seshadri and Dasgupta 1975, Kothekar 1978, Thorne 1961).

(Fig. 1)



<u>Ditylenchus</u> <u>angustus</u>: A. Adult female, entire. B. Female esophageal region. C. Female tail, lateral view. D. Larval tail, lateral view. E. Male tail, lateral view. F. Male tail, ventral view. G. Female, vulval region (From Commonwealth Institute of Helminthology 1975).

Ditylenchus angustus should be distinguished from Aphelenchoides besseyi Christie, another foliar feeding nematode pest of rice. Esophageal glands greatly overlap the anterior intestine of A. besseyi, tail ends in 3-4 pointed process, male lacks bursa, female with 2-4 rows of oocytes within ovary (Franklin and Siddiqi 1972).

Characteristic Damage

Ditylenchus angustus feeds on the above ground parts of the rice plant. Variations in foliar discoloration have been reported from the different environments in this nematode's geographical range. Seedlings sometimes develop a mottled or 'splash' pattern 1 week after artificial inoculation. These discolorations widen, especially on new leaves which often turn whitish green (Hashioka 1963). Sometimes the foliar symptoms are masked and the plants appear healthy (Ou 1972). Generally, the leaves of infected plants become twisted and malformed. The upper stems will often divide into two to four branches. Only the spike of the main stem develops to normal size.

At the heading stage, different degrees of damage are observed. The panicle may fail to emerge, it may emerge partially, or it may emerge completely, appearing twisted and distorted and with some or all of the grains unfilled (McGeachie and Rahman 1983). The severity of damage to the spike is greater when the nematode populations are higher and when they attack the panicle early in its development (Fig. 2).

The damage caused by Ditylenchus angustus can be confused with that of Aphelenchoides besseyi Christie, which causes white tip disease of rice. A. besseyi also feeds ectoparasitically on the growing points of rice plants and occurs in most of the rice-growing areas of the world, including the United States.

The two nematodes typically cause different foliar symptoms in rice. A. besseyi causes the leaf tips to turn first white and eventually brown. There is no chlorotic 'splash' pattern as on leaves of plants infected with D. angustus. Rice stem nematode induces stem and panicle twisting and distortion. Although A. besseyi incites foliar distortion, it does not typically cause twisting and distortion of the panicle (Seshadri and Dasgupta 1975, Franklin and Siddiqi 1972, Ou 1972). The symptoms induced by these nematodes may appear similar under certain geographical and environmental conditions. In Madagascar, Vuong (1969) was unable to distinguish between the symptoms caused by the two nematodes.

(Fig. 2)

Ditylenchus angustus damage to rice panicles. Left two panicles emerged with sterile grain. Right two are only partially emerged (Reproduced by permission of Commonwealth Agricultural Bureaux, SL2 3BN, UK).

Detection Notes

1. Rice stem nematodes can enter the United States in rice straw, where they remain viable for up to 15 months. Rice straw used for packing material is prohibited entry under Title 7, Part 319.69 of the Code of Federal Regulations. Rice straw imported for commercial use requires a permit and a USDA approved treatment as a condition of entry. The nematode can also enter in infected rice plants or soil, both of which are prohibited entry without a permit under Federal regulations.

2. In the field observe that the leaf blades of infected plants may show mottling arranged in a 'splash' pattern. Leaves and panicles may be twisted and distorted. Look for panicles that fail to emerge, emerge partially, or emerge with light-weight, sterile grain. At harvest time, note that rice stems bearing

healthy panicles often lie prostrate, while stems infected with D. angustus, supporting empty panicles, remain erect. Entire diseased patches may be so evident in the field (Cox and Rahman 1980).

3. Plant material suspected of being infected with Ditylenchus angustus can be sent in for identification purposes. Otherwise, rice stem nematodes may be washed off infected plant parts into a test tube of water, relaxed, and killed with a gentle heat. Then transfer the nematodes to an approved fixative (3 percent formaldehyde: 1 part commercial formalin to 12 parts water or TAF: 2 ml triethanolomine, 7 ml formalin, and 91 ml water). The nematodes can be mailed either in a vial of fixative or mounted on a microscope slide, sealed with a commercial sealant.

Biology and Etiology

Ditylenchus angustus is an obligate ectoparasite of rice. All reproduction and feeding take place on the host plant. Females lay their eggs in the tender tissues of the stem, leaves, and leaf sheaths of the rice plant. The freshly hatched larvae and the later life stages never penetrate bodily through the host tissue, but suck the sap from epidermal cells with their stylets.

As the plant grows, the nematodes move up to the new tissues and concentrate in leaf axils, internodes, floral primordia, and panicles. Under high population density, the concentrated nematode mass may appear as a white cottony weft or gray coating on the plant surface (Ou 1972).

After the rice head matures, the nematodes on the panicle and glumes become coiled and quiescent. These nematodes remain in this state until spring rains reactivate them and they infect the new rice crop (McGeachie and Rahman 1983).

Infected rice stubble and other crop residue provide the largest sources of inoculum for the next crop season. The nematodes also survive in ratoon plants (sprouts that rise from roots after cropping), wild rice, and weed host plants between crop seasons (Miah and Bakr 1977). Hashioka (1963) found no evidence of seed transmission.

Nematode populations decline steadily during their inactive period between crop seasons. Disease severity is affected by any condition that affects the length of the inactive period. If this period is extended by late plantings or spring drought, the disease severity is reduced. Conversely, low-lying fields that flood earlier and are planted earlier show greater disease severity (Cox and Rahman 1980).

Disease development and spread are accelerated during rainfall. In India and Southeast Asia, the disease can reach epidemic levels during the season of monsoon rains (July to November). The nematode can move on a solid surface if there is free water present or if the relative humidity is 85 percent or more. The rains facilitate nematode movement to all parts of the growing rice plant. Both irrigation and deepwater flooding of the rice fields provide the nematode with a means of dispersal to other plants in the same field and to other fields (Ou 1972). Infection was heaviest at 27-30° C. This optimal temperature range is common to the Indian subcontinent and Southeast Asia during monsoon season (Hashioka 1963).

The epidemiology of the nematode and consequent disease severity varies with the cultural practices and seasonal differences in rice types. In India and Bangladesh, the three types of rice grown, aman, aus, and winter rice (boro) show this variation.

Long-stemmed aman rice seed is broadcast directly into the field from March through April and is harvested in November. It grows during the months of heaviest rain in deeply flooded conditions and is seriously affected by rice stem nematode (McGeachie and Rahman 1983). In July, the nematode population in aman rice consists mainly of larvae with few adults or eggs. By August, numerous adults appear. By the end of the rice season in November or December at least three nematode generations are produced (Seshadri and Dasgupta 1975). Disease losses are often heavy because aman rice is grown in an environment that is also favorable for the growth and proliferation of the nematode.

Aus is a deepwater rice variety that matures early and is harvested in June or July. It misses much of the summer season when nematode populations are high. Consequently, losses are not severe.

Winter rice or boro is sown October through November, transplanted December through January, and harvested in April. It is either irrigated or grown where residual moisture remains from the wet season. Rice stem nematodes do infect boro, but the winter humidity is too low to favor disease development. The nematodes that remain in the stubble of this rice provide inoculum for the infection of subsequent deepwater rice crops in areas of multiple cropping (McGeachie and Rahman 1983).

Control

Good phytosanitary methods are recommended because the nematodes overwinter mainly in the remains of rice plants. Rice should be cut low, and the stubble plowed under after

harvest. Straw and crop remains should be burned. Ratoon plants should be eliminated. When possible, paddy fields should be dried when fallow, for the nematode populations steadily decrease during extended periods of dryness (Hashioka 1963).

Crop rotation every few years with a nonhost crop such as jute (Corchorus sp.) will reduce both the nematode population and disease severity (McGeachie and Rahman 1983). In another approach to cultural control, the timing of the rice-growing season is altered to avoid the pathogen. This method exploits the steady decline in nematode population that occurs between crop seasons. In Bangladesh, no live rice stem nematodes were recovered from infected rice panicles after 5 months of storage in the laboratory (Cox and Rahman 1979). In Vietnam, nematode populations declined rapidly in infected panicles harvested in late October; by February, no live nematodes were detected (Kinh 1981). Any procedure which prolongs nematode dormancy between crop seasons will reduce inoculum. This can be accomplished by delayed planting of rice and use of early maturing varieties (Hollis 1984, Cox and Rahman 1979). Transplanting rice seedlings from noninfected seedbeds later in the season rather than sowing directly into the fields, will also lengthen the nematode dormancy period in those fields (McGeachie and Rahman 1983).

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